NIMA Civil and Commercial Applications Project: Image Interpretability and Feature Extraction of Ikonos Imagery Products

UNCLASSIFIED

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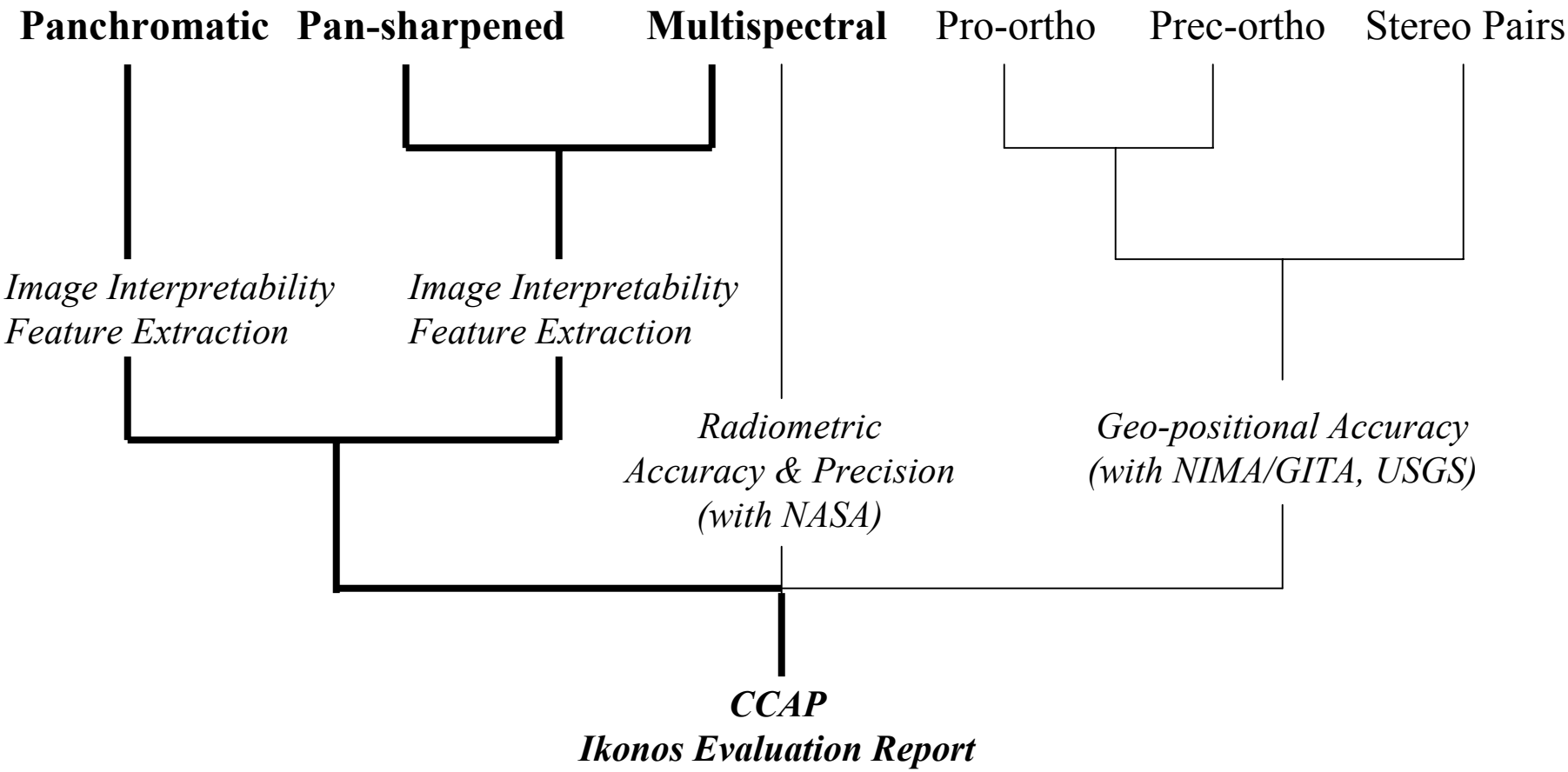
Civil and Commercial Applications Project (CCAP)

- CCAP is NIMA's resource for evaluating the utility of emerging civil and commercial satellite sensors
- Joint effort between the Commercial Imagery Program (CIP) and the Imagery Assessments Branch (ATSAI)
- CCAP is teamed with NASA and the USGS as a member of the Joint Agency Commercial Imagery Evaluation (JACIE)
- Completed CCAP evaluations:
  - Canadian Radarsat
  - SPIN-2

Scope of Ikonos Evaluation

- Evaluating Ikonos pan, MSI, and pan-sharpened products for:
  - Image Interpretability (II) for intelligence, military, and civil applications (pan, MSI, pan-sharpened)
  - Feature Extraction (FE) for mapping applications (pan, MSI, pan-sharpened)
  - Radiometric Accuracy & Precision (MSI only)
- Evaluating orthorectified and stereo products for geo-positional accuracy

Ikonos Evaluation



Imagery Parameters

- 32 scenes acquired for II and FE evaluation
- 13 scenes acquired for geo-positional evaluation
- 2 scenes tasked for radiometric evaluation
- Pan and MSI imagery of four climate regions:
  - Arid
  - Tropical
  - Temperate North
  - Temperate South

Ikonos Products Ordered (II & FE, Radiometric Accuracy)

- Level 1 (radiometrically corrected only), TIFF formatted Panchromatic
  - **11k x 11k image size**
- Level 1 TIFF MSI
  - **11k x 11k image size**
  - **B, G, R & NIR bands**
- Level 1 TIFF Pan-sharpened
  - **11k x 11k image size**
  - **B, G, R & NIR bands**

Ikonos Products Ordered (Geo-positional Accuracy)

- Level 2 (radiometrically and geometrically corrected), GeoTIFF formatted orthorectified (Pro-Ortho)
  - **Panchromatic**
  - **5k x 5k image size**
  - **WGS84 UTM**
  - **10.2 meter accuracy (CE 90)**
- Level 2 GeoTIFF orthorectified (Precision Ortho)
  - **Panchromatic**
  - **5k x 5k image size**
  - **WGS84 UTM**
  - **4 meter accuracy (CE 90)**
- Level 2 NITF Stereo Pairs
  - **Panchromatic**
  - **9k x 9k image size**

Imagery Interpretability Assessment

- Provide NIMA customers a general idea of what intelligence tasks can be accomplished with Ikonos pan and MSI data
  - Use the National Image Interpretability Rating Scale (NIIRS) and Multispectral (MS) IIRS to establish a mean rating scale value for the imagery sample:
    - NIIRS: Graduated 10 point scale designed to quantify and communicate the potential interpretability of panchromatic imagery
    - MS IIRS: Graduated 7 point scale designed to quantify and communicate the potential interpretability of MSI
  - Quantify the information content of the imagery as characterized by task satisfaction of Essential Elements of Information (EEI):
    - Based on image observables
    - Address specific intelligence tasks

NIIRS Rating

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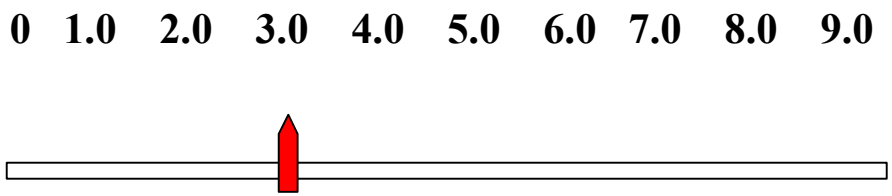
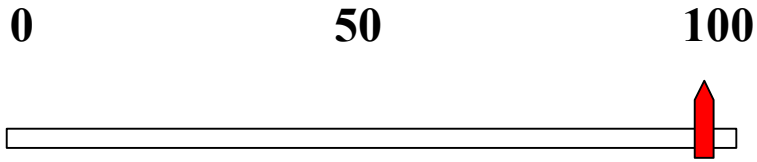


"What's the NIIRS rating for this image?"

EEI Confidence



"What's your confidence in your ability to detect large bombers?"

MS IIRS Rating

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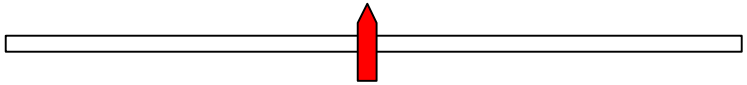
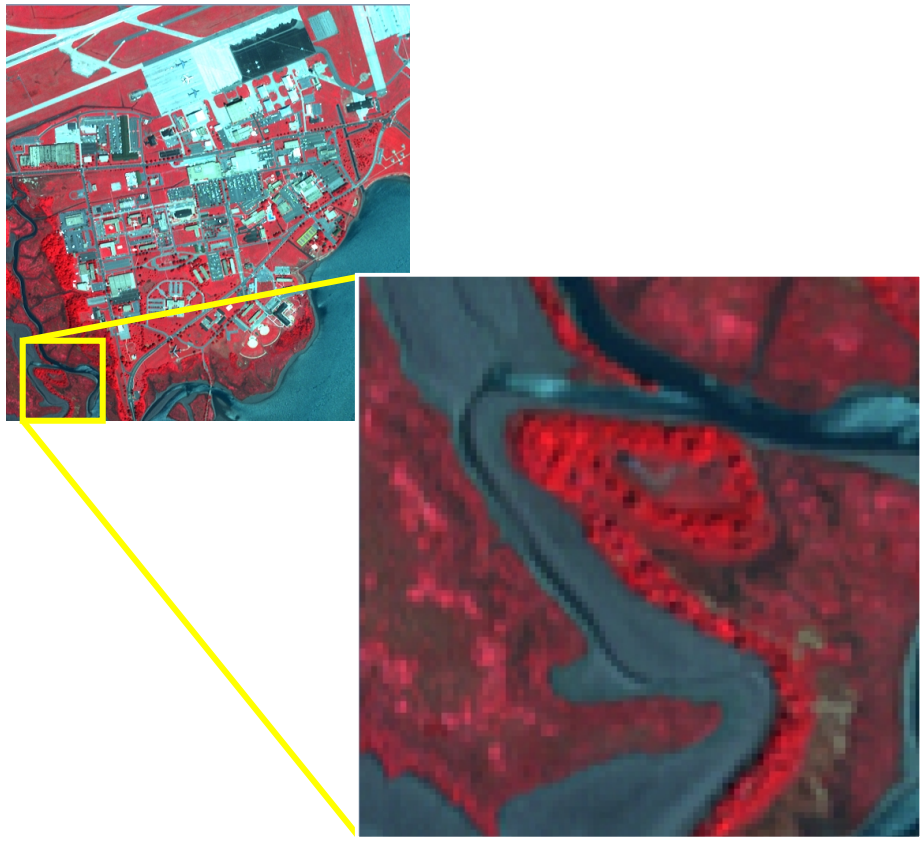
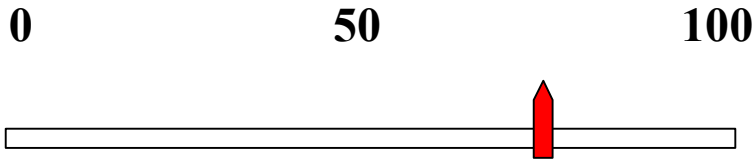
0 1.0 2.0 3.0 4.0 5.0 6.0 7.0



"What's the MS IIRS rating for this image?"

MS EEI Confidence



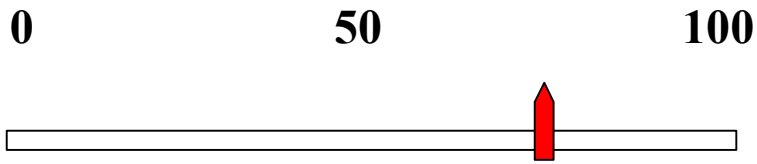


"What's your confidence in your ability to identify wetland vegetation type (e.g., mangrove, grasses, etc)"

Feature Extraction Assessment

- Provide NIMA customers a general idea of the utility of Ikonos imagery products for mapping applications:
  - Pan, MSI, and Pan-sharpened products
  - True color and false color composites displayed side-by-side
- Confidence ratings (0-100) solicited on analyst's ability to extract a given feature
- Once extracted, analyst asked attribute questions about the given feature (multiple choice)

Feature Extraction Confidence



What's your confidence in your ability to extract a railroad track from this image?

Attribute Response

What is the railroad track power source?

A) Overhead electric
B) Electrified rail
C) Unknown

Imagery Processing

- Imagery resized for evaluation display:
  - 2k x 2k pixel-sized chips for panchromatic and pan-sharpened
  - 512 x 512 pixel-sized chips for MSI
- 0.5% linear stretch applied universally to imagery
- Each chip set rotated to the appropriate cardinal direction to best align obliquity to the top of the image display

Evaluation Procedure

- Imagery evaluated by ATSAI and community Image Analysts (IAs) and Geospatial Analysts/Cartographers (GIs)
- Evaluations held on ATSAI's softcopy evaluation workstations
  - Controlled ambient lighting
  - Calibrated precision color monitors
- Display software permitted limited image manipulation:
  - Roam, 1X and 2X zoom
  - No capability to visually enhance imagery

Analysis & Reporting

- Results of evaluations undergo statistical analysis to determine:
  - Outliers (evaluators, specific images or questions)
  - Interactions between variables such as climate, GSD, etc
- Report describes procedure and incorporates analysis to present results
- Peer reviewed within ATSAI and by management chain before release to the customer

Summary

- CCAP evaluation of Ikonos not yet completed
- Once complete, results will be reported to CIP
- Methodology used in Ikonos evaluation provides a framework for evaluations of other high-resolution commercial sensors:
  - Investigate comparable products
  - Acquire same scene locations and climate parameters

CCAP POCs

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